



Illinois Department of Natural Resources

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Pat Quinn, Governor
Marc Miller, Director

September 11, 2012

Mr. Scott Lombardo
Savanna Stable, LLC
18719 Reifsteck Road
Savanna Depot Technology Park
Savanna, IL 61074

**RE: Wind Turbine Electricity Generation, Carroll County
Endangered Species Consultation Program
EcoCAT Report #1301997**

Dear Mr. Lombardo:

Thank you for your submission of this proposal for consultation pursuant to the *Illinois Endangered Species Protection Act* [520 ILCS 10/11], the *Illinois Natural Areas Preservation Act* [525 ILCS 30/17], and Title 17 *Illinois Administrative Code* Part 1075.

The proposed action is described as the installation of a single wind turbine generator with a capacity of six megawatts (or less) on the indicated parcel bounded by Robbe Road, Reifsteck Road, and Crim Road within the Savanna Depot Technology Park. This parcel falls within the area designated as the Savanna Army Depot Illinois Natural Areas Inventory (INAI) Site, and is located in the vicinity of several state-listed endangered or threatened species.

It is the biological opinion of the Department the proposed action will be likely to adversely modify the **Savanna Depot INAI Site**, and would be likely to adversely modify the essential habitat of the **Plains Hognose Snake** and the **Black Sandshell Mussel**. It is the biological opinion of the Department the proposed action would be unlikely to adversely modify the essential habitat of the **Gray/Timber Wolf**, or the **Western Sand Darter**.

Wind Turbines. The potential adverse environmental effects of wind turbines vary with a large number of factors, including whether a turbine is solitary or one of many, direct-drive or gear-box, “upwind” or “downwind,” vertical-axis or horizontal-axis, permanent magnet or electro-magnet, monopole tower or lattice tower, and many more characteristics. Many people equate size or capacity with the magnitude of potential impacts, but small residential turbines can be as or more destructive in some situations than much larger machines. Consequently, if this project moves forward, consultation should be re-initiated once a specific make and model of turbine have been chosen.

Savanna Depot INAI Site. The Savanna Depot INAI Site is one of the largest INAI Sites in Illinois. The parcel in question is a small fraction of the area formerly known as the Lower Post, where many of

the administrative buildings of the former base were located, and where many remain. The area where construction would occur can be fairly described as a minute portion of the INAI Site.

However, the operation of utility-scale wind turbines affects a far larger area than that directly disturbed by construction, due to a turbine's visibility, constant motion, shadow-flicker, noise, and vibration. Typically, power lines connecting the turbine and the substation are installed underground, resulting in soil disturbances and thermal effects to adjacent soils when the turbine is operating.

This proposal is not specific to the turbine make and model which will be selected by the developer. The largest turbines now commercially available in North America rise to just under 600 feet in height. The tallest turbines proposed in Illinois to date rise to 510 feet, while turbines in the range of 380-420 feet are more typical. Over unobstructed flat ground, turbines in the latter range can be seen with the unaided human eye for more than 15 miles. Consequently, a turbine of this size in the Lower Post would be visible from most locations in the greater portion of the Savanna Depot INAI Site.

Some species of wildlife, particularly among grassland birds, are sensitive to the proximity of vertical structures which are stationary; more may be sensitive to vertical structures in obvious motion. The distances to which this sensitivity results in displacement from habitat or exclusion from habitat are not well-understood, but generally adverse effects decline with increasing distance. Effects to vertical-sensitive species will likely be limited to those using the Lower Post, and those may already be few due to existing buildings there. Nevertheless, adding additional visible vertical structure within an INAI Site must be viewed as a cumulative adverse modification of existing conditions.

At dawn and sunset, the shadows cast by a turbine in motion may extend as far as 19 times the turbine's height. For the typical utility-scale turbine, this is roughly a mile. As the sun rises in the sky, the shadow rapidly shortens, but it also moves in a clockwise arc around the turbine tower. The location and the duration of shadow-flicker within the arc are determined by the time of year, time of day, and distance to the turbine base. Thus, duration is only minutes in some locations but hours in others; in some seasons flicker never occurs on a particular spot while in other seasons it happens on that spot every day. The size of the area affected also varies with the orientation of prevailing winds, relative to sun angle; flicker is maximized when the plane of the rotor is perpendicular to the source of light. Likewise, the intensity of such shadows varies with distance from the tower and variable atmospheric conditions. Models are available which can rather precisely predict the locations and durations of shadow-flicker, but not their intensities.

Some species of wildlife are likely sensitive to the passage of shadows, which could mimic the overhead flight of predators. Such responses may range from flight to evade capture to "freezing" in place to avoid detection. These and other responses, when provoked unnecessarily, may interfere with important life activities such as feeding, basking, breeding, nesting, and hunting. Apart from touching much of the Lower Post, shadow-flicker from a turbine in the proposed location will extend eastward beyond the Apple River, and westward to the banks of the Mississippi River. The introduction of a more-or-less constant source of moving shadows into an INAI Site must be viewed as an adverse modification of existing conditions.

Turbines produce noise from several sources: the passage of air over the blade surfaces produces the "whooshing" sounds which most people expect, but noise also emanates from the internal generator, and

from the pitch and yaw motors which control blade pitch and nacelle orientation. Pitch and yaw motor sounds are intermittent, not constant, and can be startling. Many species of wildlife can hear at frequencies below and above those typically perceived by humans, while attenuation by distance can be affected by many transient variables such as air temperature, barometric pressure, and relative humidity. Noise can also cause resonance in receiving materials, including flesh, at various harmonics of the base frequency.

Noise can interfere with communications among individual animals (mating and alarm calls) and between species, and with the ability to avoid predators or to identify prey. Such effects can produce significant shifts in the balance of local populations, producing a plague of mice, for example, which in turn can alter the success of reproduction among predators and plants. Constant noise can produce chronic stress and reduce overall fitness. At the extreme, noise can displace or exclude some species from otherwise appropriate habitat.

Turbine noise on the Lower Post will likely be less problematic—for wildlife—than if a turbine were located elsewhere in or near the INAI Site, due to other human activities which occur there, such as traffic, and which already limit habitat utility for many species. Some noise effects are additive, however, while others effectively cancel or mask other sounds. Moreover, the noise signatures of various turbine sizes, makes, and models are highly variable. For example, a smaller turbine is not necessarily a quieter machine than a larger one, and those with downwind rotors are notoriously noisier than those with upwind rotors. A proper evaluation of potential noise effects must be done with reference to a particular turbine design.

Closely related is the effect of turbine vibrations on wildlife habitat. Even a stationary turbine vibrates in the wind, and these vibrations are transmitted through the foundation to surrounding soils. For operating turbines, vibrations are closely related to the blade-passing frequency of the rotor; whenever a blade passes the tower a varying vibration pulse is produced. Hence, wind speed is a factor in producing the resulting vibrations. The introduction of a more-or-less constant source of noise into an INAI Site must be viewed as an adverse modification of existing conditions.

Organisms whose habitat lies within or upon the soils often depend heavily on vibrations originating from other organisms for sensory input. This is especially true for invertebrates, but is also true for amphibians and reptiles and, to a lesser degree, small mammals and ground-nesting birds. Turbine vibrations have the potential to mask or interfere with such sensations, with resulting modification of animal behavior which is unlikely to be beneficial. As with noise, distance is a crucial factor in attenuating the force and effect of vibrations transmitted through the ground. But transmission can also be affected by factors such as soil density, which typically varies across a given transect, and soil moisture, which can vary over time. The introduction of a more-or-less constant source of vibrations into an INAI Site must be viewed as an adverse modification of existing conditions.

The installation of underground conductors produces thermal effects on surrounding soils. All conductors provide resistance to current, which converts some of the current into heat—the higher the resistance, the greater the heat produced. Too much heat will damage the conductor, so heat losses must be allowed to protect the conductor itself. Overhead power lines dissipate heat into the air, and the flow of air is usually great enough the added heat has virtually no effect downwind. Underground, heat can only dissipate into surrounding soils. Depending on parent materials, soil density, and soil moisture, the

ability of soils to conduct heat will vary. Where thermal conduction is better, the temperature gradients will be less than where conduction is poor, but a larger area will be affected.

A number of animals which hibernate underground show high fidelity to burrow sites, returning annually to the same approximate location. True hibernators must achieve a low metabolic rate for stored fat reserves to last them through the winter, and metabolic rate is closely related to body temperature. The introduction of a heat source, where temperature differentials will be greater in the winter than at other times, may prevent successful over-wintering and result in hibernation mortality through starvation.

For cold-blooded animals, such as snakes and turtles, soil temperatures are also an important factor in reproduction. Eggs must incubate within specific ranges to hatch, and for many species slight temperature differences (2°F or less) in the nest itself determine the sex ratios of offspring. For species such as the Ornate Box Turtle, higher than normal temperatures will result in none of the eggs hatching or, if they do hatch, in producing nearly all female offspring.

While an underground conductor is a linear feature affecting a very limited area, it can also produce habitat fragmentation for soil organisms, creating a thermal barrier which soil animals may be unwilling to cross.

The Department has, to date, been unsuccessful in obtaining data regarding the degree and extent of thermal effects originating with underground conductors, and so is hampered in estimating the extent to which such effects may adversely alter existing conditions. But it is clear that thermal effects will be highly-specific to local soils and the electrical design of the circuits serving the turbine.

Although a limited portion of the Savanna Depot INAI will be affected, natural conditions in the vicinity of the turbine installation will be adversely modified by visibility, shadow-flicker, noise, vibration, and thermal conduction effects.

This location may be that which poses the least adverse modification for this type of activity available within the INAI Site, but specific recommendations to reduce or minimize adverse effects cannot be offered until a specific turbine choice is made.

Plains Hognose Snake, *Heterodon nasicus*. Formerly known as the Western Hognose Snake, this stout-bellied reptile is also an inhabitant of sand prairies and similar ecosystems, and is often found in the same areas as the Ornate Box Turtle, of which it is a natural enemy (as a predator of turtle eggs), although its primary prey consists of toads, lizards, ground-nesting birds, other snakes, and small mammals.

It can be easily confused with its close relative, the **Eastern Hognose Snake, *Heterodon platirhinos*,** and the ranges of the two species often overlap, though the Eastern Hognose is more often found in wooded areas than the Plains Hognose which, as its name implies, prefers more open habitats. They are most reliably distinguished by the coloration of the underside of the tail: that of the Eastern Hognose is always much lighter than the rest of the belly, while that of the Plains Hognose is the same dark shade as the rest of the belly.

The name “Hognose” is descriptive of the upturned scales on the snake’s snout. Unlike many snakes these species can burrow in loose soils due to these specialized scales. Though they can actively hunt, they often bury themselves with only their eyes exposed and lie in wait to ambush prey. This species spends much of its time underground for purposes of thermo-regulation and is therefore difficult to observe. Many Department records are road-kills.

The Hognose snakes are also famous for their defensive behavior. A threatened snake will flatten its body, hiss, feign strikes, and defecate. If the aggressor is not deterred, the snake will roll onto its back and pretend to be dead; if placed back on its belly, it will roll over again and repeat the display.

Because of its docile nature, this non-venomous snake is popular in the pet trade, and many populations have suffered from over-collecting. Poaching and persecution continue to be serious problems. These are aggravated by losses of habitat to tilled agriculture and development.

The Hognose has many natural enemies: other snakes, hawks and owls, and mammals such as coyotes, foxes, raccoons, skunks, and opossums. An egg-layer, its shallow nests are vulnerable to predation; neonates are about six inches long, but adults seldom reach 30 inches. Females cannot reproduce until their second year. Home ranges tend to be small, consisting of just a few acres, but individual territories are not exclusive and a few acres may hold a number of snakes.

Obviously, construction can destroy and fragment habitat, and risks killing the snake by crushing it with vehicles or through active persecution or collection by construction workers.

Shadow-flicker, discussed previously, may interfere with basking and feeding through stimulating predator-evasion responses. While prey-detection may be primarily by sight or scent, ground vibrations from turbines might interfere with successful detection and feeding. Thermal radiation effects from underground collection power lines may interfere with winter brumation, but are less likely to affect reproduction, since the nests of the Hognose are close to the surface.

The Plains Hognose Snake is cryptic and as difficult to detect, so that “visual encounter surveys” are an unreliable technique for assessing the presence or absence of this species, or the size of a population. Nor is the occasional road-kill a good barometer of numbers.

The Plains Hognose Snake has been reported from the Lower Post, once as a road-kill, with another observed near a debris pile. It is possible, even likely, that this species is present around the Savanna Stable, and may be adversely affected by the construction and operation of a wind turbine.

Recommendation #1: All contractors and employees working on the project should be trained to recognize the Plains Hognose Snake, to understand its significance to the project and the public, and be instructed how to respond to an observation or encounter with this species.

Recommendation #2: A pre-construction survey for the Plains Hognose Snake should be performed in all suitable habitats within 0.6 miles of the proposed turbine location. No disturbance related to the project should be allowed in any habitat demonstrated to be occupied by the Plains Hognose Snake unless an Incidental Take Authorization has been obtained from the IDNR.

Recommendation #3: If Plains Hognose Snakes are found near the project footprint, before-and-after radio-telemetry studies (after securing the required permits from IDNR) of their movements and responses to turbines, collection power lines, and access roads may determine the degree of any adverse effects plausibly caused by exposure to construction and operation of the wind turbine.

Black Sandshell Mussel, *Ligumia recta*. This species is present in both the Mississippi and Apple Rivers in the reaches closest to the proposed turbine location. The Mississippi is too distant for shadows to be a factor, but, in places, the Apple River is within 500 feet. Hence, if the turbine is large enough, shadow-flicker and ground vibrations have the potential to adversely modify habitat in the Apple River.

The responses of Black Sandshells and other mussels to shadows and vibrations emanating from terrestrial turbines have not been studied. They may or may not respond to such stimulation. Of potentially greater importance are the responses of fishes.

Like all mussels in North America (save one), the Black Sandshell is dependent on fish to complete a parasitic stage of its life cycle. Fertilized eggs called glochidia are expelled into the water by female mussels, and must quickly become encysted in the gills of suitable fish hosts, where the young mussels are nourished by the blood of the fish. After a few weeks or months, the juvenile mussels drop off the fish. If they land in suitable substrate they begin their independent existence.

Such a reproductive strategy has its limitations. For many species, a fish must approach the female mussel fairly closely for glochidia to have any chance of attachment; some mussels even extrude fleshy bait which trigger expulsions of glochidia when touched. For many species, not just any fish will do; it must be of a specific species or group for the glochidia to mature and to have the best chance of ending up in suitable habitat.

The Black Sandshell has been found encysted on several species of fish, but those with the highest rate of success are Walleye and Sauger. Should these species be excluded from habitat occupied by Black Sandshells, those individual mussels will be unable to reproduce. Unfortunately, the responses of Walleye and Sauger to terrestrial wind turbine shadows and vibrations have not been studied, either, but it is generally believed that most fish respond negatively to noise and shadows.

Noise (vibration) would be more-or-less constant when the turbine is operating, but shadows would fall on the Apple River only in the afternoons, and only in the narrow location dictated by that day's solar arc. Shadows would not be a factor at other times. Hence, vibrations emanating from the turbine would likely have the greater potential negative effect on Black Sandshells. There is little doubt a megawatt-capacity turbine's vibrations would be measurable in the Apple River, but whether they would affect the behavior of either fish or mussels is unknown.

Recommendation #1: The applicant should obtain or perform a shadow-flicker analysis to identify the dates and durations of potential shadow flicker on the Apple River.

Recommendation#2: The applicant should obtain as much data about vibrations produced by the selected turbine as is available from the manufacturer.

Recommendation #3: The applicant should consider supporting laboratory research on the responses of Black Sandshells and host fishes to vibrations of the magnitude and frequencies expected from the turbine at operational wind speeds, including their harmonics. Such research may indicate whether the turbine's operations will harass or interfere with Black Sandshells or their hosts.

Recommendation #4: The applicant should consider a micro-seismic study of a transect between the turbine site and the river bank to establish a baseline of current vibrational impacts.

Gray/Timber Wolf, *Canis lupus*. The Gray/Timber Wolf is no longer federally-protected in Illinois north of Interstate 80; it is federally-listed as endangered south of that highway. However, this species remains listed by Illinois as endangered, statewide, and is thus entitled to protection.

Within the last two years, Timber Wolves have been confirmed at three locations within five miles of the proposed wind turbine location. One was photographed, and a male and female were shot and killed in separate incidents. There is no evidence to suggest any of these animals were not alone at the time. However, the occurrence of both genders in the vicinity suggests the formation of a local pack is not impossible, and it is certain that animals dispersing from Wisconsin packs will continue to move into and through the area.

While wind turbines may adversely affect animals which might be preyed upon by Wolves, packs generally have large territories and dispersing wolves do not establish or defend territories. Wind turbines might alter Wolf behavior; coyotes are known to scavenge regularly beneath wind turbines for the carcasses of birds and bats, and Wolves might learn to take similar advantage. Wind turbines are unlikely to exert any adverse effect on Wolves unless a den or rendezvous are affected. Neither dens nor rendezvous are known in Illinois at the present time. Hence, a wind turbine on the Lower Post is unlikely to adversely affect essential habitat of the Gray/Timber Wolf.

Western Sand Darter, *Ammocrypta clarum*. This small fish is normally found in large rivers over sand substrates. In this vicinity it is found in the Mississippi River, but has not been documented from the Apple River.

As with the Black Sandshell and its host fishes, the Western Sand Darter might be most likely to be adversely affected by shadows and vibrations. However, the proposed location places a turbine at the probable limit for shadow-flicker, and the main factor attenuating vibration is distance. While it may be possible to detect wind turbine vibrations in Mississippi waters with scientific instruments, it is doubtful their intensity and duration are sufficient to exert any effects on the Western Sand Darter, especially considering the scale of effects experienced from commercial and recreational boat traffic.

A wind turbine at Savanna Stable is unlikely to adversely modify the essential habitat of the Western Sand Darter.

Consultation on the part of the Department is terminated, unless the applicant or Carroll County desires additional information or advice related to this proposal. In accordance with 17 Ill. Adm. Code 1075.40(h), the County must notify the Department of its decision regarding these recommendations, (if the proposed action is formally considered) whether it will:

- Proceed with the action as originally proposed;
- Require the action to be modified per Department recommendations (please specify which measures if not all will be required); or
- Forgo the action.

This consultation is valid for two years unless new information becomes available which was not previously considered; or the proposed action is modified; or additional species, essential habitats, or Natural Areas are identified in the vicinity. If the project has not been implemented within two years of the date of this letter, or any of the above listed conditions develop, a new consultation is necessary.

The natural resource review reflects the information existing in the Illinois Natural Heritage Database at the time of the project submittal, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments.

If additional protected resources are encountered during the project's implementation, the applicant must comply with the applicable statutes and regulations. Also, note that termination does not imply IDNR's authorization or endorsement of the proposed action. Please contact me if you have questions regarding this review.

Sincerely,



Keith M. Shank
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cc: Julie Yuswak, Carroll County Zoning Department

